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Published in:
Meaningful Play 2014

Publication date:
2014

Document Version
Også kaldet Forlagets PDF

Citation for published version (APA):
Weitze, C. L. (2014). An Experiment on How Adult Students Can Learn by Designing Engaging Learning Games. I *Meaningful Play 2014: Conference Proceedings* University of Michigan Press. http://meaningfulplay.msu.edu/index.php

An Experiment on How Adult Students Can Learn by Designing Engaging Learning Games

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Abstract

This article presents and discusses the first iteration of a design-based research experiment focusing on how to create a motivating gamified *learning design*, one that facilitates a deep learning process for adult students making their own learning games.

Using games for learning has attracted attention from many teachers as well as researchers because of their promise to motivate students and provide them with deep learning experiences. Part of the young adult target group in our current case has motivational issues in the formal learning environment, and the use of learning games is therefore worth investigating as a motivational learning strategy. As meaning can be constructed through the manipulation of materials, which facilitates reflection and new ways of thinking, the use of learning games in education is taken one step further into the building of learning games in collaborative settings. It is proposed that this may be an approach that enables deep and motivational learning processes.

The paper discusses which elements, practices, and processes are essential when creating innovative and motivating learning designs for teachers and adult students. This gamified learning design enables the students to be the designers of their own learning, by allowing them to create their own digital learning games, while implementing learning goals from cross-disciplinary subject matters (Figure 1). Another focus has been to create a learning design that scaffolds the students' own learning-game-design process, and enables teachers to evaluate whether the students have been successful in learning their subject matter.

The findings suggest that the current learning design comes partway toward facilitating learning and making the experience engaging. But to enable a deeper learning process, there is room for improvement. Future topics of research are: how students are facilitated in establishing learning goals, how teachers and students engage in the learning experience, and introductory suggestions for students on how to design the learning-experience inside their learning game.

Keywords: Game Based Learning Design, Game Design Models, Students as Learning Designers, Design Process, Learning by Design, Constructionism, Design Based Research, Co-Design.

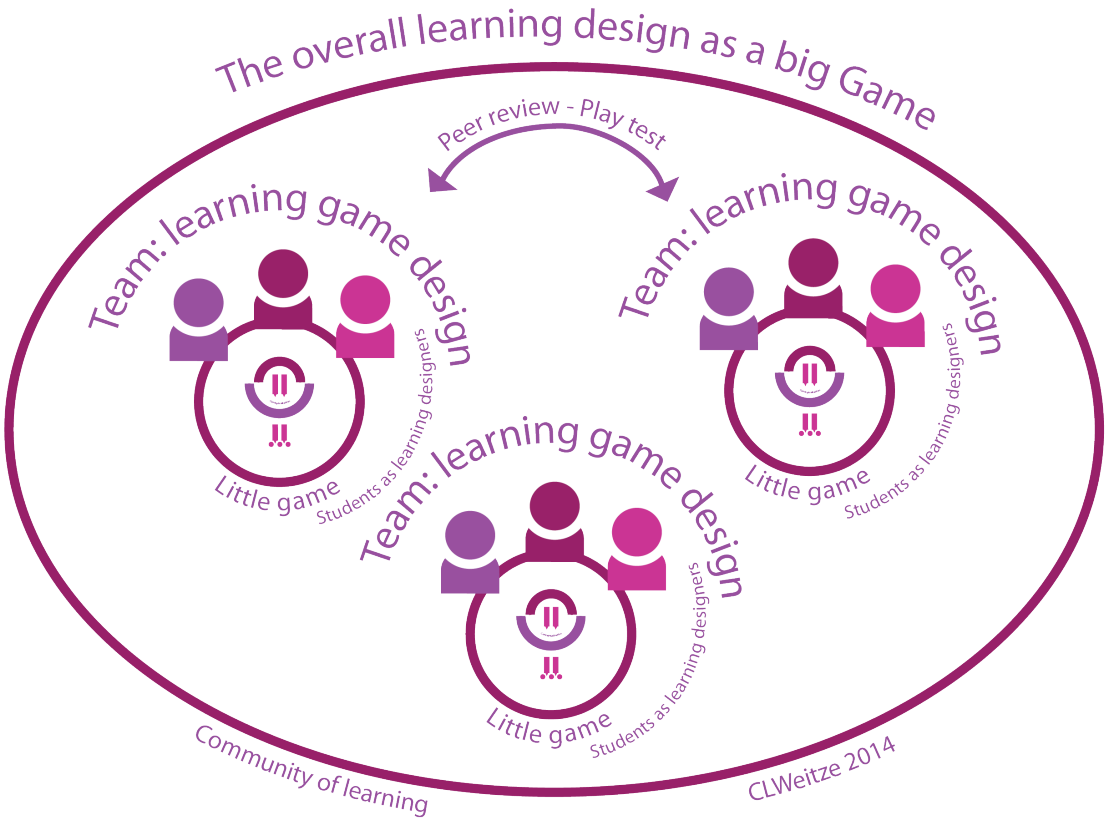

Figure 1: Gamified Learning Design.

An Experiment on How Adult Students can Learn by Designing Engaging Learning Games

Introduction

This section introduces aspects of how good games and good learning processes relate to one another. First, the potential of using good games for learning is described. Then I argue why meaning, motivation, and creativity should be considered important to the learning process for young adults. This is followed by a description of what benefits this constructionist approach may have in supporting the learning process.

The number of teachers who utilise games for learning as a way to vary the traditional learning processes within formal education, continues to grow. Many scholars have argued for using learning games in education as a potential means for learning (Gee, 2007; Barab, Gresalfi & Ingram-Goble, 2010; Tobias & Fletcher, 2011; Connolly et al., 2011). Ratan and Ritterfeld (2009) investigated 600 learning games and found that these learning games had been used for practicing skills (48%), cognitive problem solving (24%), gaining knowledge through exploration (21%), and learning social skills (7%). This indicates that learning games may potentially be used to develop the cognitive, affective, and psychomotor domains (Ratan & Ritterfeld, 2009). Although this seems promising it should at the same time be considered that numerous studies have found that there is no optimal pedagogy effective across every subject matter, and that the nature of the content and skills that are to be learned determines what type of instruction and learning activities will be most effective (Dede, 2011). Therefore, when researching how to use learning games in education and aiming at facilitating the learning process, it is important to have a focus on the subject matter, the curriculum, the context, and the characteristics of the students and the teachers (Dede, 2011).

When designing games for learning, the learning game designers generally aim to design games that trigger learning and motivate students deeply (Gee, 2005). Learning games can be created to provide learning trajectories for the learner/player by encouraging them to identify with

the game-characters' roles and assignments as a means to guide the student through the learning process. By building principles of learning into good games, the aim is to empower learners, teach them problem solving, and enable understanding of the subject matter (Gee, 2005). The student can choose to follow his own storyline by making in-game choices. By becoming familiar with the problems, tools, experiences, perspectives, and consequences in the learning environment's gameplay, the aim is that the learner will develop a richer understanding of the subject matter being taught (Barab, Gresalfi & Ingram-Goble, 2010).

German professor of pedagogy Thomas Ziehe believes that there has been a de-conventionalisation—a change in young people's knowledge, behaviour, and motivation (Ziehe, 2012). For young people and adults, it is essential to be able to see the meaning in what they are asked to learn, in order for them to be willing to engage in the task, and to use their time and energy to solve it. If the task is interpreted as meaningless, it will not spark their motivation to learn. In an institutional setting, this can be interpreted by the teacher as resistance against learning. Resistance to learning is a common adult reaction, since as adults we are used to being responsibile for ourselves, and can therefore decide what we choose to learn and what we choose not to learn. This resistance is necessary in certain situations, as the amount of information in our complex modern society that could potentially be learned is so overwhelming that it exceeds the capacity of a single adult mind (Illeris, 2012).

Another reason for resistance and lack of motivation in young adults comes from self-understanding stemming out of earlier bad experiences. For example, a student might earlier in life have experienced anxiety from not being able to meet the demands of school. The student's motivation to learn helps establish interest in the subject matter, and it is, therefore, an important contributing factor to the learning process (Tanggaard, 2013; Koster, 2005; Weitze & Ørngreen,

2012). The question is how to spark the students' motivation, helping them to find personal meaning, while at the same time reaching the learning goals in the curriculum.

Designing the learning experience so that students have part of the responsibility for their own learning process may be a way to make the learning experience meaningful and thereby more motivating (Knowles, 2012; Hutters et al., 2013). Young people are also very willing to be guided into the meaning of the task by skilful and inspiring teachers (Tanggaard, 2013). These strategies towards motivational learning demand that teachers themselves be creative when making learning designs and experimenting with new ways of learning and evaluating. Developing a more creative workforce trained in problem solving may contribute to create new and valuable changes in society (Tanggaard, 2013; Resnick, 2008). The integration of creative and innovative elements in the learning process may, if well facilitated, be motivational and meaningful factors for the students. This creative freedom might also inspire the students to be their own learning designers, choosing problem areas from their own life-world and thereby creating meaning in their daily lives.

This project experiments with a learning design where students create games for learning, embedding learning goals into their created games. The term *learning design* is used to describe how to shape social processes and create conditions for learning as well as the phenomenon of the individual constantly re-creating or re-designing information in their own meaning creating processes (Selander & Kress, 2012, p. 21). A learning design will typically consider prerequisites for learning, setting, learning goal, content, learning process as well as evaluation/assessment (Hiim & Hippe, 1997). Beyond working with the creative game design process, the project also aims at scaffolding and evaluating the learning process for the student game-designers, as well as to facilitate the learning process for the players who afterwards will play the game. Some schools have already begun to work with "gamifying" (applying game-elements to non-game environments (Deterding, 2011)) the curriculum for different age groups and for different lengths of time. For

example, Quest to Learn, a public school in New York, has a pedagogical strategy that aims to transform the learning experience by using the underlying structure of games as its foundation for its curriculum (Salen, 2011).

There has been research on other attempts to allow students to create their own learning games that focus on specific issues (Macklin & Sharp, 2012), and this research suggests that using game design as a vehicle for developing successful curricula is difficult for the students. Michel Resnick and Yasmin Kafai (Kafai & Resnick, 1996; Kafai, 2006; LCL, 2014) have worked for many years using the constructionist approach, letting students construct games as a method of learning. One of their fundamental ideas is that there is a strong connection between design and learning, and that activity that involves making, building, or programming provides a rich context for learning (Kafai & Resnick, 1996). Piaget's constructivism, which focuses on the students' construction of meaning as a condition for learning, is taken further by Papert's constructionism theory that emphasises that meaning in particularly can be constructed by the making of artefacts (Kafai & Resnick, 1996). The construction of these artefacts enables reflection and new ways of thinking, based on the tools the students use alone as well as in collaboration with peers (Kafai & Resnick, 1996; Kafai, 2006). Learning and creative development happens when the material *talks back* to the students in unexpected ways in the development process (Schön, 1992). This happens, for example, if the constructed concept turns out differently from the student game-designer's intended vision. This *talking back* can thereby spark creativity in the designer, who will have to engage with dilemmas that arise out of the discrepancies between the *situation* (the actual learning situation the student is designing for), the *vision* she has for the learning game, and the *actual* learning game as it has been conceptualised during the stages of the design process. Handling this dilemma forces the student to learn, be innovative, and create new concepts (Löwgren & Stolterman, 2004).

Case Study

VUC Storstroem, an adult learning centre in Denmark, has applied the Global Classroom (GC) concept—a hybrid synchronous virtual and campus-based videoconference classroom concept—to an upper secondary general education program, a full-time education which lasts two years. By breaking down the walls of the classroom, the aim of this class is to offer a flexible learning environment that responds to the needs of young adult learners (20–30 years old) to complete an education while fitting it into family and working life. The teachers can be said to be teaching in multiple rooms at the same time, since they are working synchronous as both traditional classroom-based teachers as well as online teachers; with part of the students attending individually via videoconference from home and represented via video and sound in class on a screen. Therefore the teachers are both represented in the classroom as well as at home with the students staying home. Generally the teachers prepare their daily learning design without knowing how many students will be in class and how many will be attending online. However, the teachers can ask the students to attend in person on specific days.

The previous part of the research project detailed in this paper experimented with developing a continuous competence developing practice: the “IT Pedagogical Think Tank for Teacher Teams”. This new practice aims at enabling the teacher-team to reflect, innovate, and create solutions for the constantly occurring IT-related pedagogical issues on a theoretical and practical level (Weitze, 2014b&c). Since the students are the end users, it is now the aim to focus on experimenting and examining how to create innovative and motivating learning to suit them.
It is important for the teachers who use GC to create a motivating learning environment for the students. According to the questionnaire surveys and interviews with the students and teachers, the group that uses GC in VUC Storstroem is diverse. GC students have different academic levels and different reasons for being in adult education, as well as different ages, life-situations, and

experiences. This is confirmed by a new report about VUC (EVA, 2014). The report also finds that the adult students approve of activities with playful elements and that this engages and motivates them. However, the report also stresses that teachers must take the time to explain and describe the academic purpose of the playful activities, so that these are known to the students (EVA, 2014). The activities for the 2nd and 3rd workshops have been designed for the hybrid synchronous GC class environment. However, the focus of this paper will mainly concentrate on the conceptual learning game design process in the first workshop, one that is taking place exclusively on campus. This is new research as regards the combination of the target group, setting, and gamified learning of game design.

Research Objective and Methodology

This research is an experiment in creating and qualifying innovative and engaging learning designs for the students. The study is conducted as a combined Design-Based Research (DBR) and Action Research (AR) study, using the best and most meaningful approaches from both (Majgaard, Misfeldt & Nielsen, 2011; Susman & Evered, 1978). After the diagnosing and action-planning phases (Weitze & Ørngreen, 2014a), the research has proceeded to steps four and five in AR: taking action and evaluating (Susman & Evered, 1978).

The research uses qualitative methods to investigate how the DBR learning game design experiments answer the research question. The data (Table 1) includes field notes, audio- and videotaped utterances as well as observations from the workshops, informal meetings with the teachers, documents written by the students, questionnaires, playtest assessments from the students, and student videos of the playtest of the games (Table 1). The analysis is made from the coding of the data using the qualitative research software NVivo, carried out as concept-driven (using concepts from the theory and previous empirical data to find themes in the data), as well as data-driven coding (reading the data and searching for new phenomena which are not known from its

previous preconceptions of the subject) (Kvale 2009). The questions for the research process become: (a) Which elements, practices, and processes are essential when creating reusable, innovative, and motivating learning designs for teachers and adult students? (b) How does the learning design contribute to enable a motivating and deep learning process? The medium for this experiment is design of learning games, and the setting is the Global Classroom teaching concept.

1) Observations of teaching in Global Classroom
2) Questionnaire of Global Classroom students and teachers
3) Co-designing innovative pedagogical workshops with teachers
3) Four meetings; continuous interviews with teacher team; briefing and debriefing
4) Three four-hour learning game design workshops with students
5) Material from student workshops, game concepts, playtest videos, game homepage, playtest questionnaires and learning-design documentation

Table 1: The material from the Fall 2013-Spring 2014 research process

Research Design

Seventeen students and three teachers from GC participated in a learning design experiment (Spring 2014) on designing learning games, implementing specific subject matters. The aim was to facilitate a motivating learning experience for the students by making the whole learning design into a game. The experiment was conducted with pre-, mid-, and post-experiment conversations with the teachers. It was explained to the teachers how this learning design would unfold in class, and the researcher listened to them as co-designers, interviewing and observing them as facilitators and evaluators of the subjects of history, religion, and social studies. The research was initiated by an earlier game-experiment in the IT pedagogical think tank for GC teachers in (Weitze, 2014b&c), where a teacher team experimented with creating a DNA learning game for the GC students. In the previous DNA game-experiment, the task was to create the learning design in a way that enabled the students to participate synchronously from campus or via videoconference from home. In that experiment, the teachers discussed how the process of designing learning games could become a new and innovative way of learning for the students in Global Classroom. One of the factors, the

teachers emphasized, was that, with their knowledge of the students, it would be important to motivate them by offering them to design a 'cool' digital game. Therefore the choice of software became Gamesalad (gamesalad.com), compatible with both PC and MAC. The aim was that by choosing this kind of platform, the students could (with a lot of work) turn their games into app, should any of the students turn out to have those ambitions. Another user-friendly feature of Gamesalad is that it uses a fairly easy drag-and-drop method for game programming.

The learning game design process was itself gamified in the experiment by embedding it in an overall class game with different levels of assignments/missions (referred to hereafter as the big Game). Gamifying the learning process is not a new phenomenon. For example, Lee Sheldon describes it in his book, *The Multiplayer Classroom: Designing Coursework as a Game* (2011). In the current experiment, the big Game continued over the course of three four-hour-long workshops. For upper secondary students, this was a long time to spend on a classroom experiment regarding reaching the curriculum. But it is very little time when both teachers and students are novices in game-design. However, by combining the lessons from history, religion, and social studies, it was possible to find the time. The experiment is the first iteration of a reusable gamified learning design.

Theoretical and Grounded Analysis of the Empirical Data

I will begin by describing the theoretical frame for the experiment. This is followed by a description of the themes and content in the learning game design workshops. The article then considers the student as learning designer when implementing learning into games. Following this, the paper explains how the structure of the learning process is built into the game levels. An analysis is carried out to find out what is learned in and around the games, followed by theory-based suggestions on how to improve learning in the games. To elaborate on those pieces of advice, the article ends with three sections: (a) a description of how to enable situated in-game learning, (b)

a discussion of the teacher's supporting role as a facilitator of learning in game-based learning design, and (c) a discussion of technological implications to be considered in the learning design.

Theoretical Frame

The choice to gamify the learning design, or create a big Game, was chosen partly to make it a motivating and engaging experience for the students. But it was also chosen to be able to scaffold, and quite strictly guide, novices through the process of learning game design. The aim was to facilitate a deep learning process within the subject matter being studied through the making of learning games. The *Smiley Model* (Figure 2), a learning game design model for building engaging learning games (Weitze & Ørngreen, 2012), was used to scaffold the learning game design process. This model inspired the gamification of the big Game by providing it with structure, ensuring that the learning goals from the curriculum were implemented in the game. It also helped the students with guidelines on how to make a motivating game, by outlining both general game elements and more specific motivational elements. The overall gamified learning design of the experiment (the big Game) is described, analysed, and discussed in another article (Weitze, 2014d).

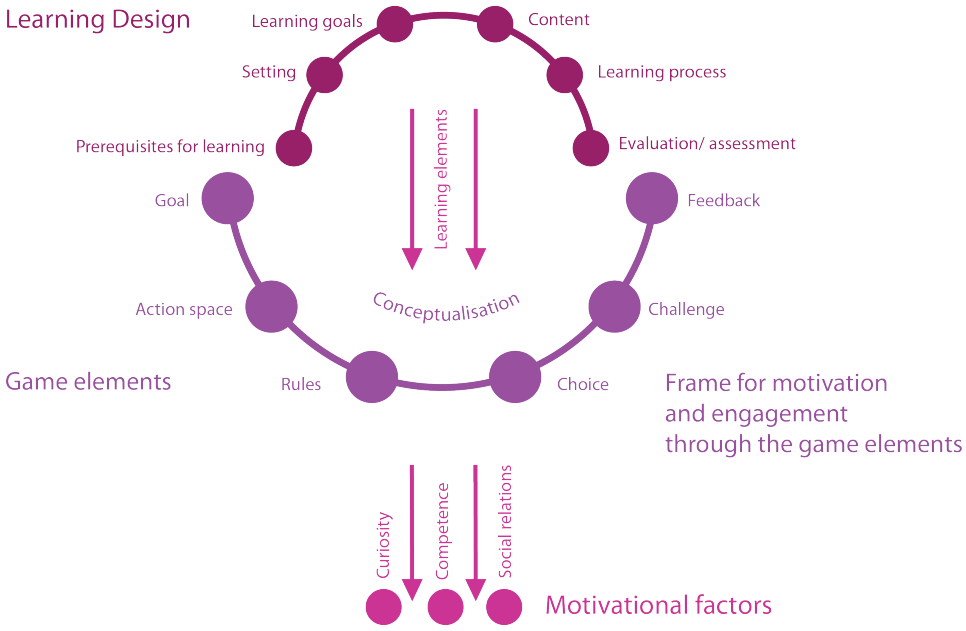

Figure 2: The Smiley Model (Weitze & Ørngreen, 2012)

When discussing the potential learning processes that can happen when playing learning games, James Paul Gee (Gee, 2011), literary and learning game theorist, uses the concepts the little 'g' game and the big 'G' Game. These concepts are used to distinguish between what happens inside the software game (or inside the player's mind when playing this little game), and 'outside' in the big Game in all the interactions between the players/learners when they discuss and negotiate the meanings in the game, while learning during the process. By gamifying the learning game design process, the aim is to structure and facilitate the learning process of the big Game, while building the little game. In the current project, the aim is that the students will discuss, negotiate, and finally master the learning goals when participating in the big Game as they build and implement the learning goals in the little game. If the experiment works out well, their fellow students will also gain knowledge, skills, and competence when playing their created games. It is well known that the art of learning game design is difficult (Flanagan et al., 2010), and it is therefore an ambitious goal to aim at facilitating deep learning through playing the small games. The most realistic ambition for the learning design in this experiment is therefore not that deep learning will happen inside the small games, but rather around the small games—in the big Game.

Themes and Content in the Workshops

The three workshops, lasting four hours each week, were divided into three themes: (a) concept development of the learning games (focus: conceptual game design implementing the subject matters); (b) introduction and experiments with the digital game design software (focus: digital game design tools); and (c) building the learning games on the digital platform (focus: digital game design of the subject matter). This was an ambitious plan. It also did not turn out completely as planned, but the analysis describes the lessons learned.

It was the teacher's decision that the students should use the design of learning games to repeat what they had learned in the three subjects (history, religion, and social studies) over the

previous month. In the first workshop, the teachers presented the different learning goals from the three subjects. Students could choose between these learning goals for their learning game design. In preliminary interviews, the teachers explained that a traditional evaluation method for measuring whether the students had reached the learning goals would be to assess if the students could explain, discuss, and critically think about the concepts from the curriculum. This would be evaluated as having a complex level of understanding the learning goals.

Implementing Learning into the Games—The Student as Learning Designer

The aim for this learning design is to integrate areas of relevant academic subjects into the little game and allow the students to become their own learning designers. Another aim is that the students get deep into the learning process and content of the various subject matter to be learned. They should examine the academic knowledge, become reflective about the academic knowledge—and consequently become academically proficient. Instead of being 'told' the academic knowledge, they 'do it themselves'—they direct their own learning trajectory and create learning games that can be played by their fellow students. In this way, students become the designers of their own learning. They organize their own learning processes and collaborate, discussing ideas and possible solutions. The goal is to immerse students in a learning experience that allows them to tinker with a problem in a project/problem-based learning process.

Building the Learning Process into the Levels of the Game

The students were divided into five teams. Each team developed their learning game concepts by following the instructions in the overall gamified learning design (the big Game). They received points as they solved different tasks, moving from one level to another in the Game. Since this learning design contained part of the traditional subject matter of the class, the overall Game was designed in a way that aimed at ensuring, as well as measuring, whether the students were

learning during the design process, and if their chosen learning goals were implemented in their created games.

For example, to pass Level 2 (see Table 2), students had to describe several aspects of their learning design in writing. By making this very explicit to students, it was intended to scaffold the students through a learning process and support the teachers that were new to this kind of gamified learning design. Level 2 encompassed questions (see Table 2) inspired by Hiim and Hippe's learning design model (1997), and equivalent to the upper part of the Smiley Model (Weitze & Ørngreen, 2012):

Level 2: Learning in games (10 minutes) – Learning design concepts
1. Read and talk about the learning objectives for the subject matter. What can each of you remember—what do you think was interesting and that you might want to create a learning game about? (Write down your goals in a, b, and c)
a. Religion: Civil religion, rituals, and myths. Write down your team's learning objectives for learning the game:
b. History: Critique of sources, tendency, national identity. Write down your team's learning goals for the learning game:
c. Social Studies: Economic cycle financial and monetary policy, welfare models, economic conditions in the USA (Balance of payments, debt, minimum wages, tax issues). Write down the team's learning objectives for the learning game:
Write briefly about the learning that must take place in the game:
2. Who is the target group for the game?
3. If you have to teach someone, enabling them to achieve the learning objectives, how would this traditionally be done? (Learning process and activities)
4. If you were to teach someone, enabling them to achieve the learning objectives, how would you then traditionally examine whether they had learned this—how do you evaluate it?

Table 2: Questions for Level 2 in the overall game

The students wrote down their answers to these questions (from Table 2), and the learning goals were also to a certain extent apparent in some of the learning game concepts. But although these were adult students in an upper secondary class, most of the students did not show signs of a deep understanding of traditional teaching and learning concepts. For example, when asked how they would teach someone to enable them to achieve the actual learning objectives the students answered, “PowerPoints; history books; teaching from the smart board”; and when asked how they would traditionally evaluate someone, the answers were, for example, “Quizzes, tests”. The students’ suggestions thus did not encompass any description of active learning approaches such as class discussions, problem based learning, enquiry based learning approaches, or the like.

Since the students learning design development process, as well as the game design process, are both designed to be iterative processes in the big Game, the learning goals and the learning process in creating the student games were addressed and questioned in many ways at different levels in the big Game, and also in playtests that student teams carried out with other teams. The students brainstormed on creating game narratives that could encompass their chosen learning goals, and documented their explicit learning goals for the game.

After this the students, now at Level 5, also had to consider the question, “*How can you assess whether the learning objectives are achieved (both in traditional education and in your game)? Consider that this may also take place "outside” your game; i.e. by asking the player questions subsequently”*. To answer these kinds of questions about the learning design, the students have to understand what learning goals, learning processes, learning activities, and evaluations are. Even if it is only understood on an implicit level, this can be detected when analysing their answers. When analysing the students’ answers to the learning design questions (Table 2), as well as the learning implemented in many of their game concepts, there were only signs of learning on the cognitive complexity level of *remembering*—not encompassing other cognitive complexity levels

such as *understanding, applying, analysing, evaluating*, or *creating* (Bloom, 1956; Anderson & Krathwohl, 2001, 67-68).

The above observation calls for including an initial discussion with the students on learning design in general, to qualify their knowledge and considerations about learning goals, learning processes, learning activities, and evaluation processes. Designing learning objectives with Bloom, Anderson, and Krathwohl's different cognitive levels in mind gives an overview of how and at what level we can expect our students to be able to master the learning goals of the Game. To deliberately take these higher cognitive levels into consideration will also help make the learning goals easier to measure when we evaluate what has been learned in the big Game and at what level of cognitive rigor (Hess, Jones, Carlock & Walkup, 2009).

Learning goals are traditionally incorporated in the curriculum by describing the following 3-4 areas: knowledge, skills, and competencies/attitudes (Hiim & Hippe, 1997; Winterton, Delamare-Le Deist & Stringfellow, 2006), which describe what knowledge and intellectual abilities the students should achieve. These concepts are also worth discussing with the students within the specific subject matter. To become the designers of their own learning, students should be conscious of how their skills, knowledge, and competences are traditionally expressed in the subject matter. The characteristics of these three (or four) concepts describing the learning goals can then inspire actions in creating student games: (a) setting knowledge goals that describe which knowledge and intellectual abilities the students should master; (b) practical application of skills which demonstrates their knowledge and what they can do with their knowledge; (c) competence, interpreted as learning goals which cover a combination of theoretical knowledge and practical skills (Winterton et al., 2006) and (d) learning goals that encompass feelings, attitudes, and values (Hiim & Hippe, 1997)—an expression of feeling a new identity. To inspire the students to enable these learning goals in the small games the students can try to complete the following sentence:

"After playing [the specific game], the player/learner should be able to [recognize/ demonstrate/ calculate/ decide/ evaluate/ formulate] [a fact, concept, topic, theme, task, activity, or skill] (Hiim & Hippe, 1997).

Analysis of the Games—What Is Learned

One of the experimental aims in this project was to let students choose exactly how to design their own game concepts. The goal was to let the innovation process be free and draw from the students' own life experiences. At the beginning of the first workshop, the students were introduced to the concept of the big Game. To inspire the students, they were also briefly introduced to small meaningful games such as *The Oregon trail*, *Fitter critter*, *Free rice*, *Carmen Sandiego*, *Darfur is dying*, *Hush* and *12th September*, to give ideas and set the stage for something other than a full-blown 3D game. Apart from this brief introduction to small meaningful games, students were *not* introduced to examples of learning games that could be built in the specific Gamesalad platform, since the intention was not to introduce game concepts that then could be copied, in order to give the students freedom to invent their own games.

As a result of this approach, students instead used game concepts they already were familiar with as templates or inspiration for their learning game concepts. As these were not learning games, this may have influenced how difficult or easy it was for students to implement learning into the game concepts they chose.

The students made the following game concepts:

Figure 3: Shooting game with quiz

1. A shooting game with quiz questions (Figure 3), where the player had to shoot until he hit a specific object, and afterward he had to answer a question.

Figure 4: Quiz game

2. A quiz game (Figure 4), where the lotto disk turned and stopped on a question that the player then had to answer.

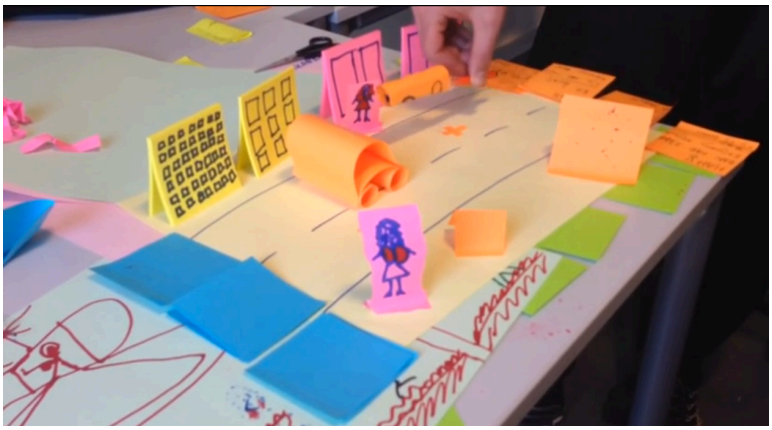

Figure 5: Racing game with ”cultural objects” and quiz

3. A racing game where cultural objects were passed on the way that ended with quiz questions (Figure 5). This game, about a specific religious orientation from the student's religion curriculum, also ended with a quiz, but before reaching the final quiz, the player was 'inside' the game and passed different obstacles that reacted to him. The obstacles provided feedback, and thereby gave him experiences related to the cultural beliefs of the religious culture being studied.

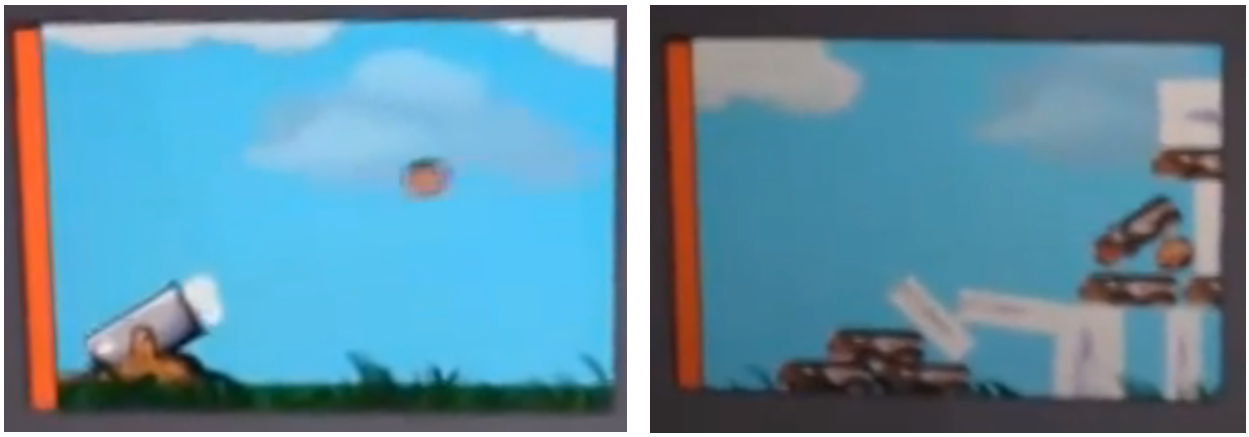

Figure 6: 'Angry birds' game with quiz

4. A digital 'Angry birds' game with quiz questions (Figure 6). In this game, the learning was not really connected to the gameplay itself; the students had chosen to use the head of a political leader they had recently learned about as the cannonball in the game. In this iteration of the game, the learning was therefore detached from the little game.

In a preliminary meeting prior to their workshops, the teachers created a concept for their own learning game. This exercise took place so the teachers could develop an understanding of the learning design in both the big Game and the small games. In the teacher's concept, they decided on two themes inspired by the goals of the curriculum: one about slavery and one about industrialism in the US. As the teachers' concepts developed through their discussion, the ideas they had about their learning game grew into a rich narrative, presenting the possibilities of different choices with different consequences, and a underlying storyline that would lead the player/learner in the direction of how the story had been in real life. The teachers also joked about discovering areas in

American history that they agreed they still had to learn more about in order to develop the game further. The impression was that if they had continued developing their learning game further, they would have gained new knowledge, would have had many discussions about how best to implement the learning goals in their game, and would have thereby engaged in a collaborative problem-based learning process.

Analysis of the Games—What Was Learned and How to Improve Learning

When analysing the learning that took place in the first iteration of the students' games (Level 6 in the big Game), it is quite clear that, apart from *The racing game with cultural objects* (figure 5), the only game with aspects of situated learning objects in its gameplay, that all the games in this iteration were only developed to the *remembering* level of cognitive complexity (Bloom, 1956; Anderson & Krathwohl, 2001). In fact no learning was facilitated in most of the small games, they were only evaluating or assessing if learning had taken place already.

When analysing the questions posed in the games, most of the questions in the students' quizzes in this first iteration were composed so they either (a) were exactly consistent with what the students had learned in the previous lessons, and therefore could only be answered if the player knew the exact answer in advance; or (b) were made so the questions posed were common knowledge, ones most people would be able to answer.

As for (a), the students experienced a repetition of the curriculum through the questions they made, and might also in the big Game have engaged in discussions on what quiz questions to implement in their own games. This would make them engage with the learning goals—but on a basic level of cognitive complexity. As for (b), another aspect to consider when evaluating the learning implemented in the little game as well as in the big Game, is that as this is only the first iteration of the student learning games, the students seem to take the learning less seriously. As one of the students uttered in a playtest with another team, 'Don't mind the questions, these are just

prototype questions'. Here the students have their focus on the game development to a greater extent than on implementing deep learning possibilities in the game, and are thereby pushing away the learning process.

All in all, this first iteration of the overall learning design leaves room for improvement if the students are to achieve a deeper level of learning in their subject matter while creating learning games. As the goal is to facilitate motivating learning processes by creating learning games, the focus is on improving the possibilities for deep learning processes at higher levels of cognitive complexity. Though the students' games may develop in later iterations during the big Game, the short time in which they are able to interact with the curriculum in a qualified way, in an upper secondary class, makes it important to seek fast ways to gain deep learning.

According to Wenger (1998), knowledge can be constructed in learning communities, or communities of practice, along several paths: by participating in a learning situation or context, by learning from and with other people or materials, and by working with, experiencing, and negotiating meaning in these situations until reaching individual meaning and a sense of individual identity within these contexts. We must bear in mind that this individual *meaning* may only be temporary, as it always can be renegotiated in a never-ending process. The big Game here has aimed to create a community of practitioners and a situated learning experience for them by creating teams as well as by establishing opportunities for peer review through playtesting. But perhaps the same situated learning situations should be applied toward structuring the development of the little games. By facilitating student games to become situated learning experiences, these games provide an opportunity to learn for the players/learners who play the game. This can happen if the learner identifies with characters in the game, explores the learning context, negotiates meaning, and makes choices that have consequences in the game. This situation may make the

learner more involved and affected by the tasks and choices he makes, in a way that lets him identify with what his non-human actor or avatar learns in the little game.

An inspiration for creating these situations in the game might be the previously mentioned sentence that had been inspired by Hiim and Hippe (1997): "after playing [the specific game], the player/learner should be able to [recognize/ demonstrate/ calculate/ decide/ evaluate/ formulate] [a fact, concept, topic, theme, task, activity, or skill]. Of course, students have a very limited amount of time to construct games in a digital medium that is unfamiliar to them. But to 'level up' the cognitive complexity and learning opportunities in the student games, and thereby also in the learning design of the big Game, this way of facilitating learning by creating learning contexts and situations inside the game may be of help and should be explored in future iterations of the overall learning design.

When analysing the second or third iterations of the games that the students made (since an idea phase iteration preceded the earlier illustrated and described iteration [Figure 3-6]), it appeared that the student games with the potential to be situated places for learning were the *racing game with 'cultural objects'* and quiz (Figure 5), as well as the teachers' game concept ideas described earlier. In these two examples of games, there is the potential for an expansion of student games into learning situations, since the conceptual characters in these games interacted with different learning elements implemented in meaningful narratives.

Enabling Situated Learning in the Small Games

Many scholars in the field of learning game design are investigating what is important to include when creating games that are good for learning (Gee 2005, Steinkuehler, Squire & Barab, 2012; Tobias & Fletcher, 2011). While their recommendations are intended for professional learning game designers, there might be features to learn from when the students design their own learning games. One piece of advice is to attach the learning objectives to the game by embedding

an identity or character that can be used to empower the player. By creating identity-based objectives, you can provide context for additional—and more complex—learning. This can happen, for example, by creating situations where the learner/player, through the character in the game, achieves a sense that the choices made are significant and have consequences that will bring new options in the game. This can happen in a context with problems, perspectives, experiences, people, tools, and consequences that facilitate the players' learning (Barab, Gresalfi, & Arici, 2009).

This is very much in line with Wenger's (1998) community of practice taking place in the 'real world'. James Paul Gee's previously mentioned principles of learning in good games have many of the same elements as a situated learning environment, one that empowers the learners by teaching them problem solving and enables understanding of the subject matter. There is not room for an elaborated description of Gee's thirteen principles here (see the appendix for a summary of the principles). But though it may be ambitious to expect that students build Gee's principles into their games, they are all relevant as inspiration for building a situated learning environment, and will be used in the future when re-designing the current learning design for this way of learning through building learning games.

The Smiley Model (Figure 2) (Weitze & Ørngreen, 2012) has been used as inspiration for the assignments in the big Game's learning design, and has many of the elements that are important for implementing learning into the small games. The model, for example, encompasses relevant learning elements, as well as game elements including goals, action space, rules, choice, challenge, and feedback. In the current learning design, the students start out dealing with the learning elements in order to make sure to implement these into the game. This is then to be followed by assignments concerning the game elements, 'tweaking the games' to make them fun and motivating in later iterations. However, the experience from this experiment shows that in order to enable a situated learning experience inside the little game design, the game element *action space* (meaning

the context and narrative for the game) from the *Smiley Model,* becomes vital to fully engage with in the construction of the little game from the very start, since the students engage in building their game concepts action spaces from the very beginning.

The Teacher's Supporting Role as Facilitator of Learning

In this experiment, all three teachers were unfamiliar with the learning concept, and did not have any experience with building games. Therefore the intent of this experiment in the first place was to let the teachers participate as 'students', while I as researcher participated as facilitator/teacher of the learning design in the big Game. However, in the workshops it was not natural for the teachers and students to be at the same 'level of study'; so instead of sitting down and building their own learning game, the teachers took on their traditional role as teachers by wandering around in class and observing the students working in groups, and by being open for questions from the students.

As this study found, the students would have benefitted from initial discussions about the general concept of learning design and learning approaches to facilitate a deeper learning process. Therefore, this would be a relevant discussion for teachers to engage in with their students. I had asked the teachers to document the specific learning goals for the learning games in the beginning of the project, and created a list of points of attention for the teachers to observe concerning signs of learning among the students. The teachers were new to this learning design, and that could explain the few formative evaluations they performed in the workshops. However, by making formative evaluations during the workshops, assessing and enabling a deeper learning process for the students would be a good way to qualify the learning design in the future.

Technological Implications

The first of the three workshops was in many ways a successful experience, apart from the finding that the learning process should be facilitated for a deeper learning experience. The students were very productive and motivated.

However, the second workshop, introducing the digital game design tool Gamesalad, was a very different experience for the students—it is a complex task for students to be digital game designers (Kafai, 1996). This workshop was facilitated by the help of the questions and tasks in the Game and by providing a special made homepage with a 'tool-box' of video tutorials for the game tool, which enabled step by step game building tasks, chosen with the purpose of making learning games. The students were also offered a joint review of the tutorials, but they decided to carry on working in their individual groups. The subject of this workshop was thus not about the three subjects from the curriculum, but about the medium or software platform that should enable the students' learning experience in this experiment: Gamesalad. Digital game design was therefore in some sense added to their curriculum. Some of the students found this frustrating and did not completely approve. Another obstacle was that students using PCs experienced software problems.

There were several lessons learned in different areas in this second workshop concerning the students. First, the demand that students be self-directed and responsible for their own learning process, by watching and imitating the videos, as well as the assignments asking them to reflect on how to transform their analogue game design concepts into digital concepts, was too difficult for many of the students in this target group. Second, the learning curve was too steep for some of the students, and this needs to be addressed in future experiments. Third, the student group did not prioritize to use time between the workshops on homework, which made it even more difficult to get familiar with the digital design tool. Fourth, while the teachers in the co-design process suggested having examples of learning games demonstrated in the actual game-tool there were no

such examples for the students in this initial experiment, in order to let the innovation space be 'open'. As the experiment turned out, presenting examples of games created with the game tool may be a good idea in future iterations of the learning design. Perhaps this can be combined with hints on how to construct a situational learning environment in the actual game tool from the very start of the workshops.

Papert's (2002) expression *hard fun* describes the phenomena that everyone likes challenging things to do, as long as they are the right things matched to the individual and to the culture of the times. The intent of this learning design is to establish a feeling of *hard fun* in the digital game design phase as well as in the conceptual phase before. But this will still need some tinkering with the big learning Game design.

Conclusion

The findings in this study suggest that when using the current learning design in the gamified learning environment, the upper secondary students from Global Classroom are able to develop concepts for small learning games and implement learning goals from their subjects of study. However, the overall learning design still has room for improvement, since the level of learning achieved in the students' first attempt to create games, as well as in the discussions around the games did not reach above the cognitive complexity level of *remembering*.

To deepen the learning experience facilitated in the big Game, students would benefit from teacher-initiated discussions about the concepts of learning goals, learning processes, learning activities, and evaluation processes, in order to better qualify the students to become the designers of their own learning experiences. The use of the Smiley Model as a frame for making engaging and motivating learning games was of good use to guide the structure of how to implement learning into the small games. However, to deepen the learning process in both the big Game and the small games, there are substantial reasons to implement changes so that the small games also can become

situated learning environments. These should be inspired by the constructive reasons of why and how to facilitate learning processes in situated learning environments/communities of practice (Wenger, 1998), and supported by the experiences from learning game designers (Gee, 2005). This can happen by making sure to provide opportunities for the players/learners playing the game to identify with characters in the game. These characters can then explore the learning context, negotiate meanings, and make choices that have consequences, thus enabling the learners to identify with what their non-human actors experiences and learns in the little game.

In this experiment, some of the students found it difficult to be responsible for their own learning in relation to use the game design tool, and also found it too challenging to try to transform their analogue game design concepts into digital concepts. Therefore, future experiments will demonstrate examples of learning games in the actual digital game-tool and combine this with scaffolded tutorials with hints on how to construct a situated learning environments in the actual game tool from the beginning of the workshops/learning design.

This game-based experiment came partway toward making a reusable, innovative and motivating learning design for the adult students and the teachers, focusing on how to create motivating and qualified learning. It also contributed to enable a motivating learning process. However, the overall learning design or big Game still needs some tweaking to establish the feeling of *hard fun* in the design- and development- processes of digital learning games. It will also be essential to improve and increase the teacher-initiated discussions that will qualify the learning taking place during the game design process.

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Appendix

Summary of James Paul Gees article: Gee, J.P. (2005). Learning by Design: good video games as learning machines. *E–Learning and Digital Media, 2*(1), 5-16. Symposium Journals.

The principles of learning in good games are listed into three sections: Empowered Learners, Problem Solving and Understanding.

With the *Empowered Learners* the following themes are of importance:

1. Co-design: Games let the learner feel like an active agent, letting him engage actively and thereby learn by doing, while at the same time having the freedom to do what he likes. This is a highly motivating feature.
2. Customize: Games are customizable; they let the learner have an influence on how to learn, thus enabling different learning styles, making it more engaging and easier to learn.
3. Identity: By letting the learner identify with his avatar in the game, he has the opportunity to experience being an apprentice within the learning area, which most likely will be a more engaging and memorable experience than just listening to or reading about the subject in class.
4. Manipulation and Distributed Knowledge: Human perception and action are deeply interconnected, and we are able to relate deeply with the things we can do in games, thus adding games to the cultural tools we already use to store and process our knowledge, like paper and pen, musical instruments, or computational calculators.

The next thematic section to take into consideration is *Problem Solving*:

5. Well-ordered Problems: By letting the learner experience well-ordered problems in the game—designed in a way that leads him to hypotheses that are of use and will work well later, when he has to solve even harder problems—the learner/player thus will be able to gain a notion of how to proceed in later parts of the game and thereby, the learning.

6. Pleasantly Frustrating: This motivates the learner to stay in the place where he is challenged. The task is still “doable”, and at the same time it gives the learner a feeling, as well as evidence of, where progress is being made, and where he fails (please also see the paragraph: “Designing learning objectives for feedback”).

7. Cycles of Expertise: By being very clear when showing how far the learner/player has come in the game and showing when he passes the current level, the game enables and encourages the learner to work towards mastery at each level. This is to be encouraged because in order to get to the next level, the game lets the player repeat his skills until they become automatic, thus leaving cognitive space for the next skill to be trained simultaneously with the previous skill in the next level, on the next challenge.

8. Information: ‘On Demand’ and ‘Just in Time’: Games are good at giving verbal information at the appropriate time and place in a concrete context; this goes very well with human cognitive abilities, as we have a difficult time processing a lot of verbal information given out of context.

9. Fish Tanks: By creating small simplified eco-systems, or ‘Fish Tanks’, in the game, starting out with a simplified interacting model of a complex system, it is possible for the learner to interact with the system, getting to know it little by little, and then letting the game gradually add a bit more complexity, with the end result that the learner understands the complexity of the whole system and how it interacts.

10. Sandboxes: By letting the learner play in a ‘sandbox’, a safe place that simulates real world scenarios—but without its risks and dangers—the learner will have an opportunity to learn by doing, and even by making mistakes.

11. Skills as Strategies: In games, you can design learning in a way that lets the learner practice a skill as part of a strategy to accomplish the goals of the game. In this way, the learner will feel like

the practising is part of a strategy to accomplish his game-goal, removing the attention from the traditional boredom of practicing the same thing over and over again.

The third and final thematic section is *Understanding,* encompassing:

12. System Thinking: When learning the rules to games, the underlying "system" of the game is revealed for the learner. By interpreting the meaning of this system, the learner learns what strategies, skills, and ideas scaffold this system, and in that way a game will enable the learner´s thought process and mental system building.

13. Meaning as Action Image: By letting the learner/player experience the meaning of concepts and words through the activities he carries out in the game, the learner gets to "live and think" through these experiences. This supports a more experimental and imaginative way of exploring and learning a concept than through logical principles and definitions (Gee, 2005). These principles can be seen as possibilities of building learning into games. When implemented into learning games, the games can be used to explore big problem spaces, as well as for inquiry and problem-solving, due to their multidimensional nature.